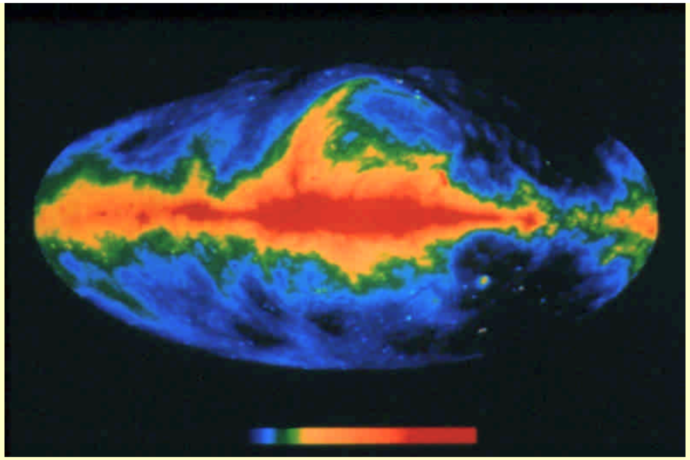
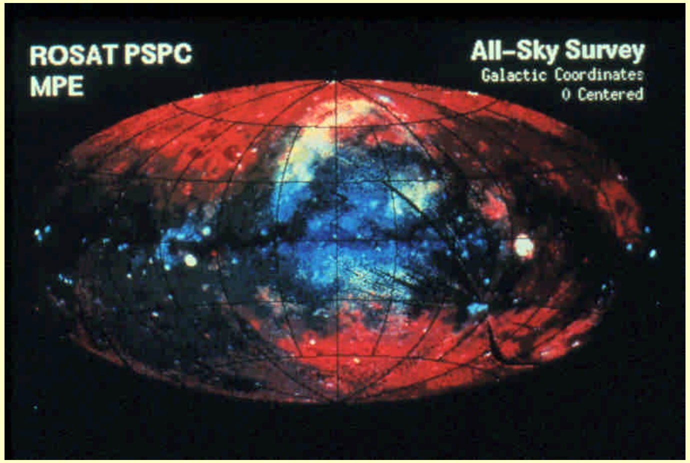
The Multiwavelength Universe

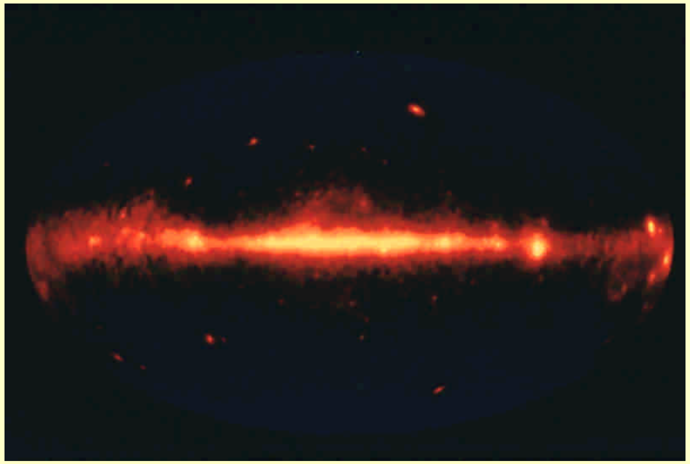
from radio waves to gamma rays

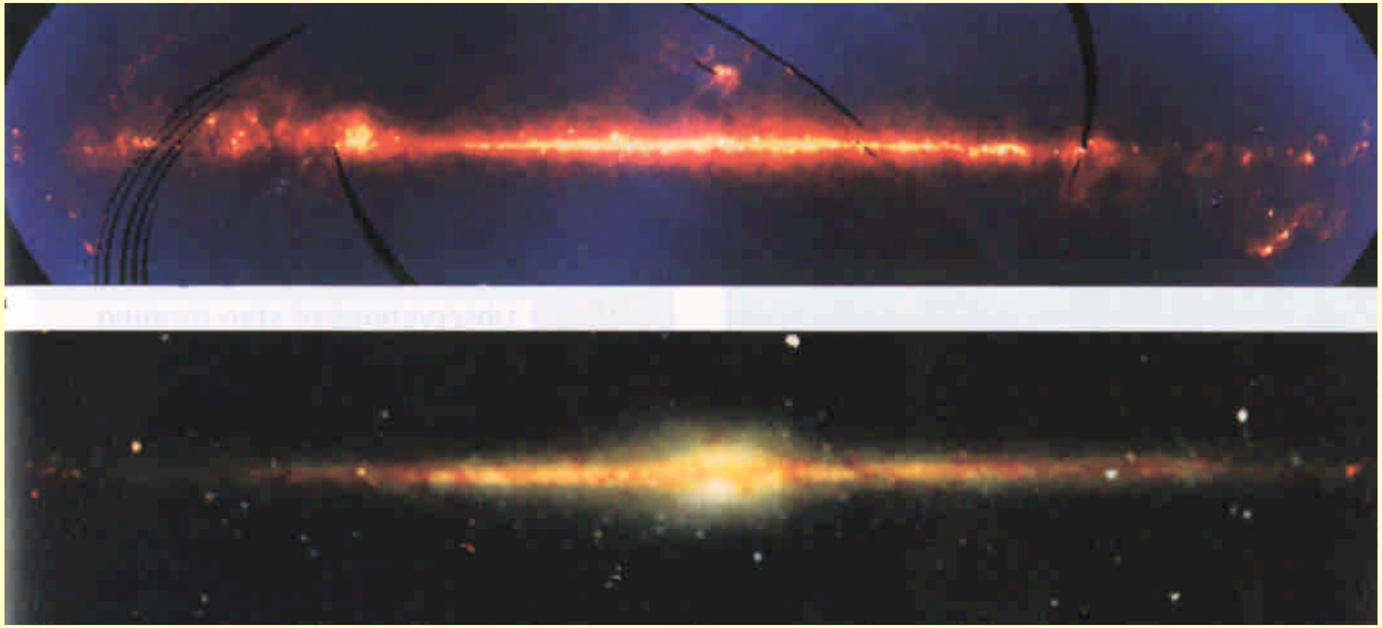
國立清華大學 物理系與天文所 張祥光

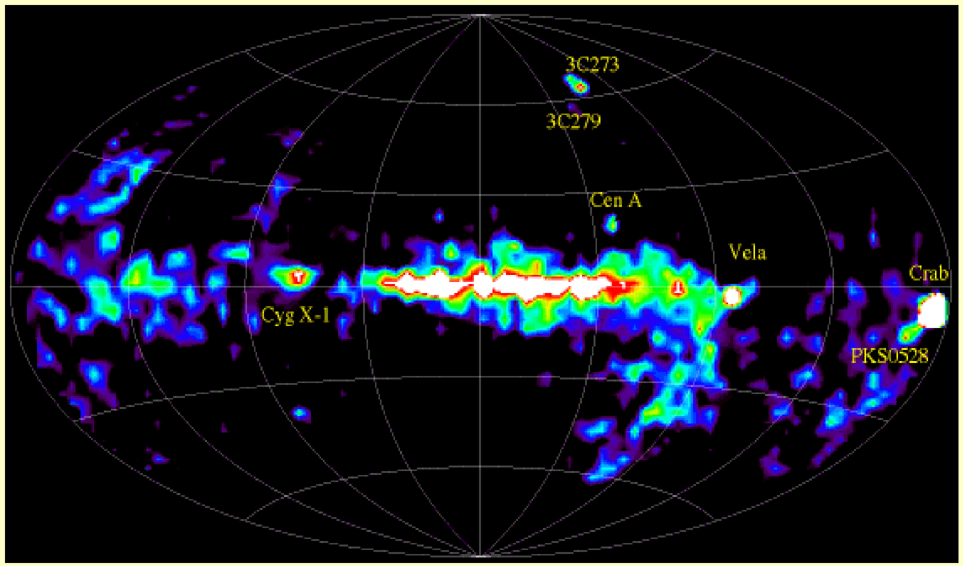
NTHU, April 11, 2006

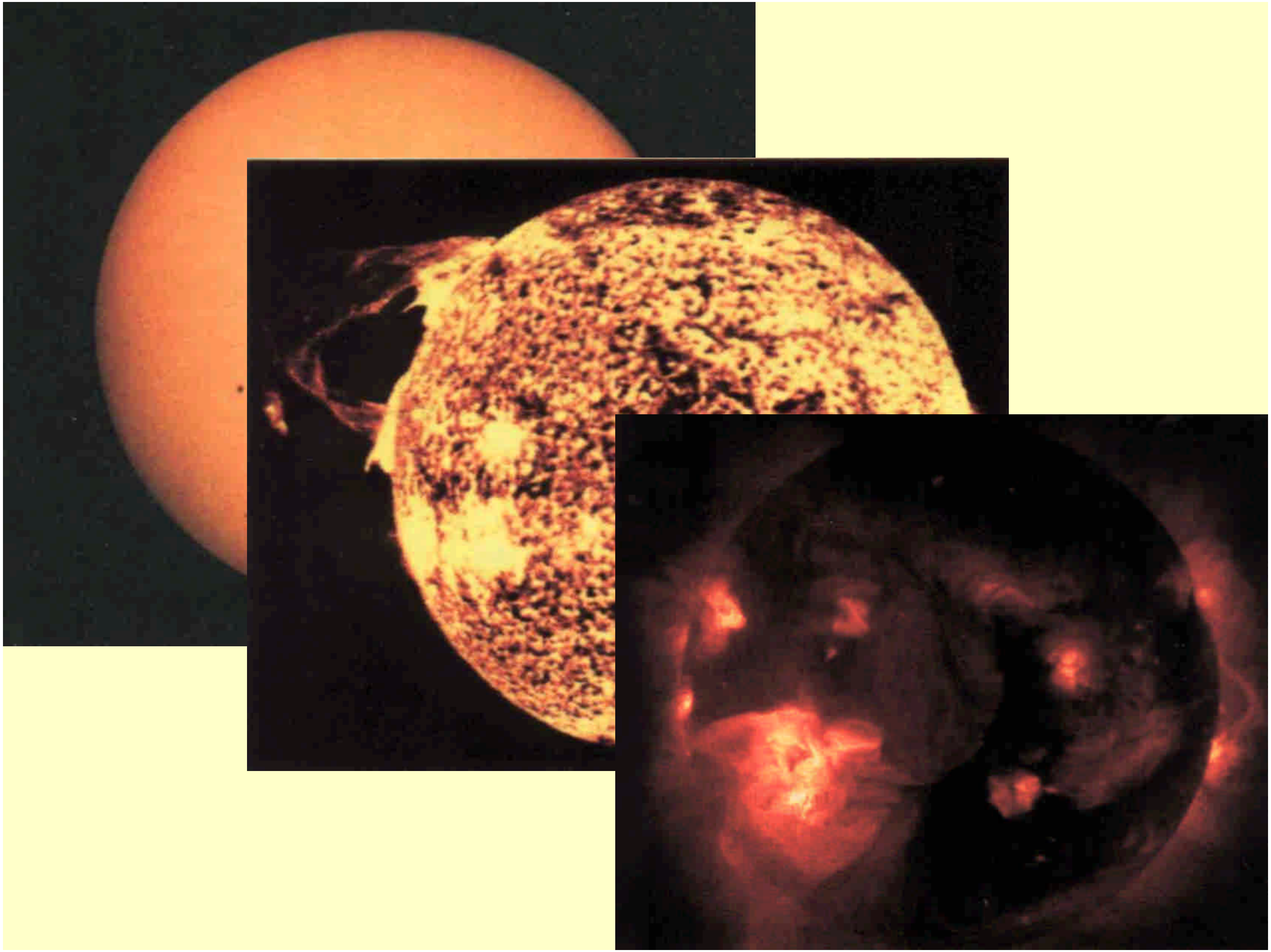


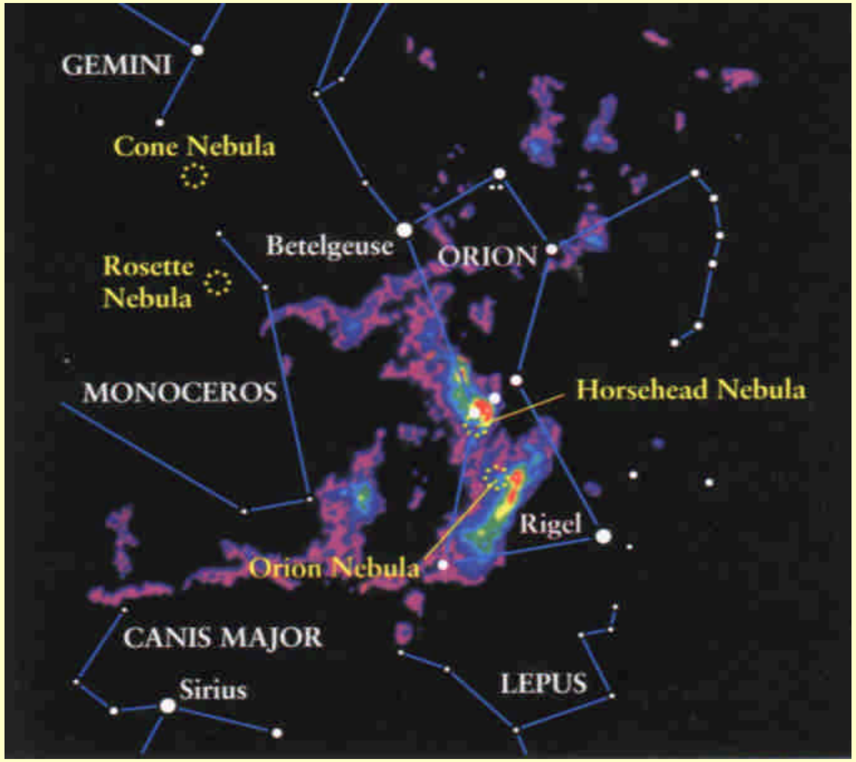

ROSAT PSPC
MPE
All-Sky Survey
Galactic Coordinates
0 Centered

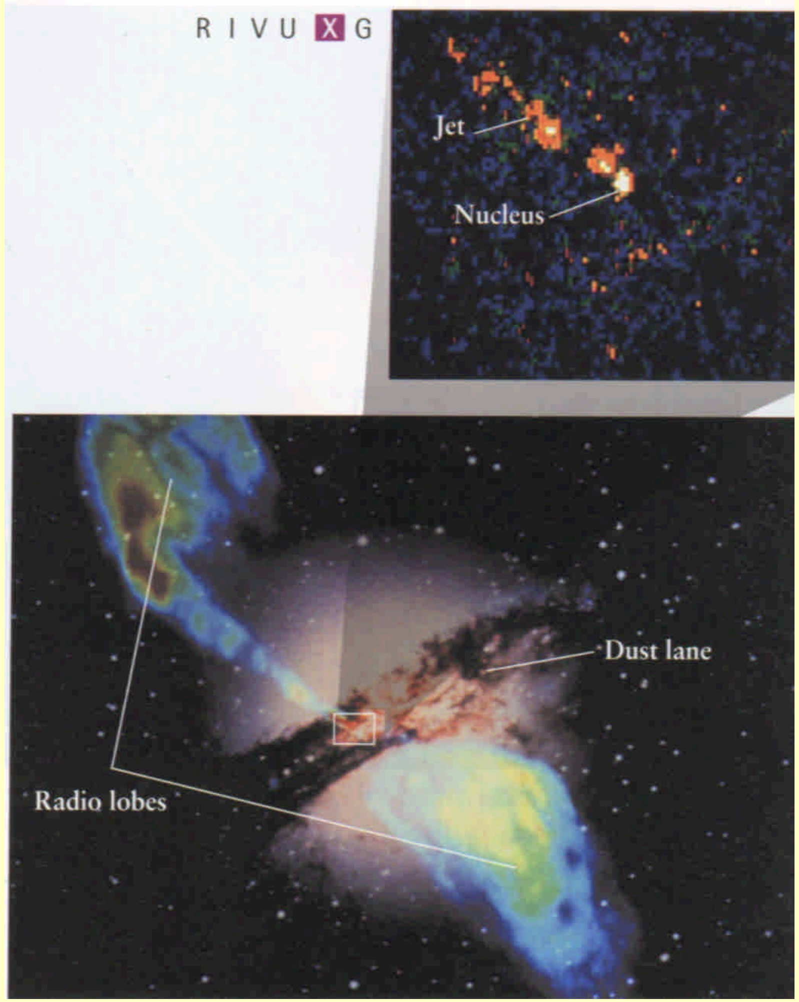




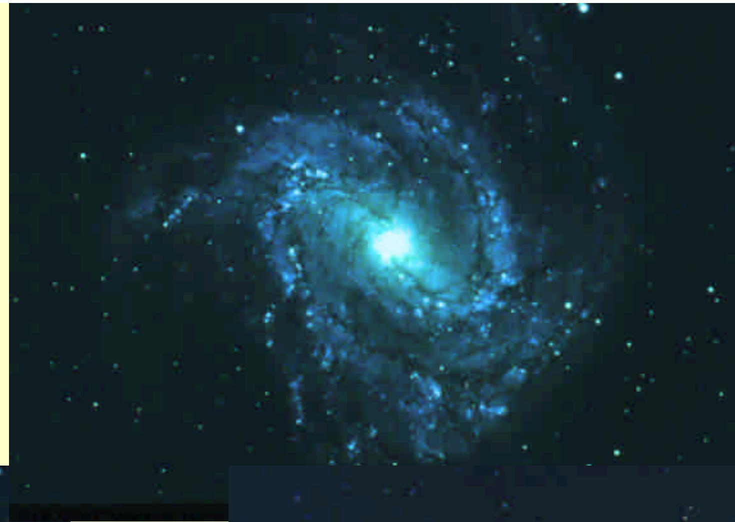

3C273
3C279
Cen A
Vela
Crab
Cyg X-1
PKS0528

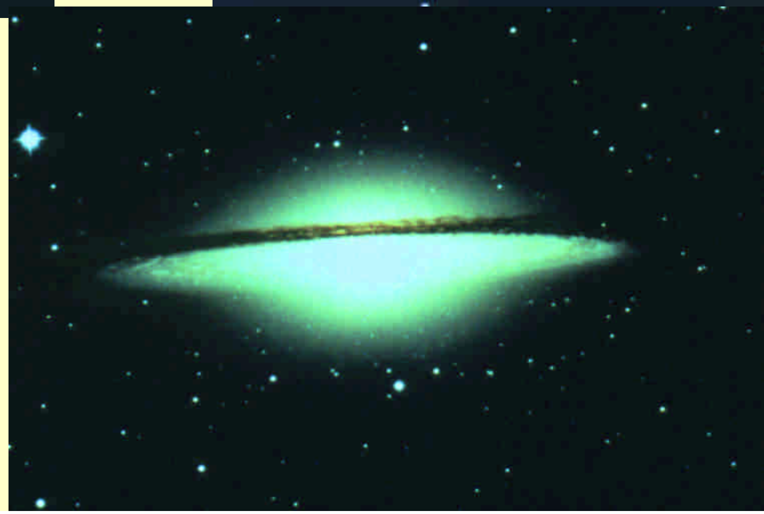


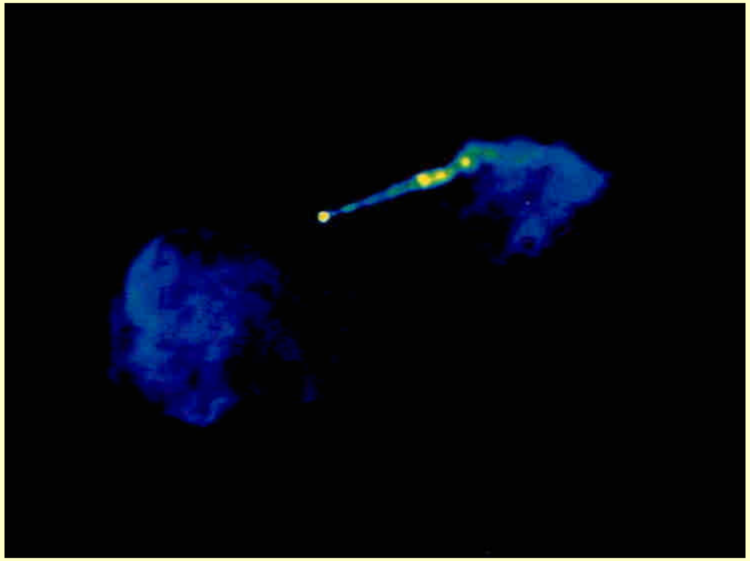
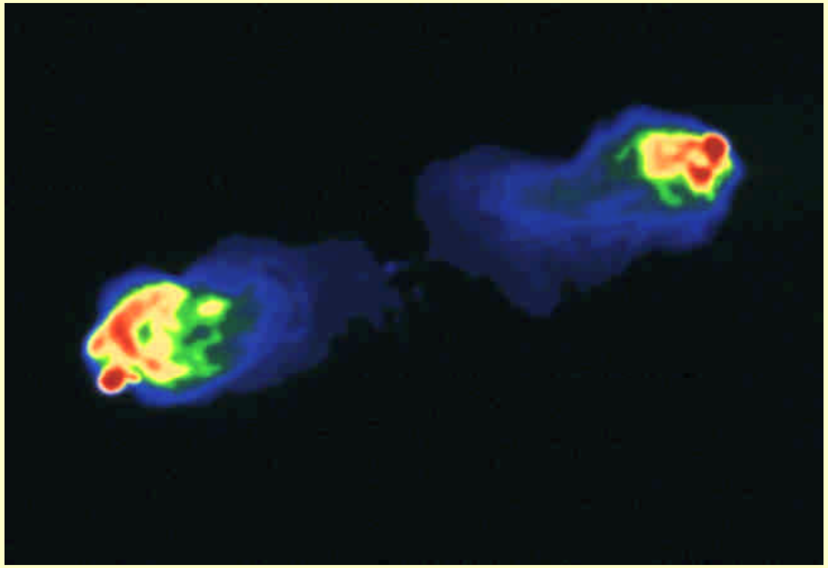
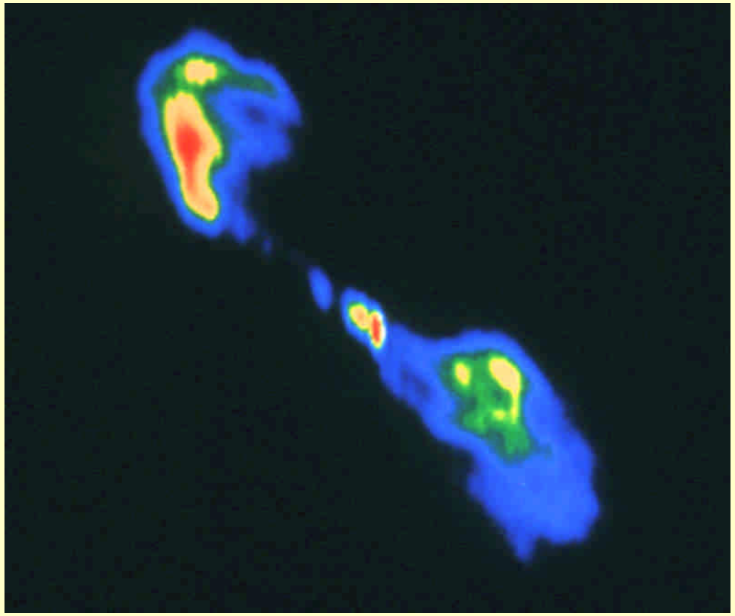
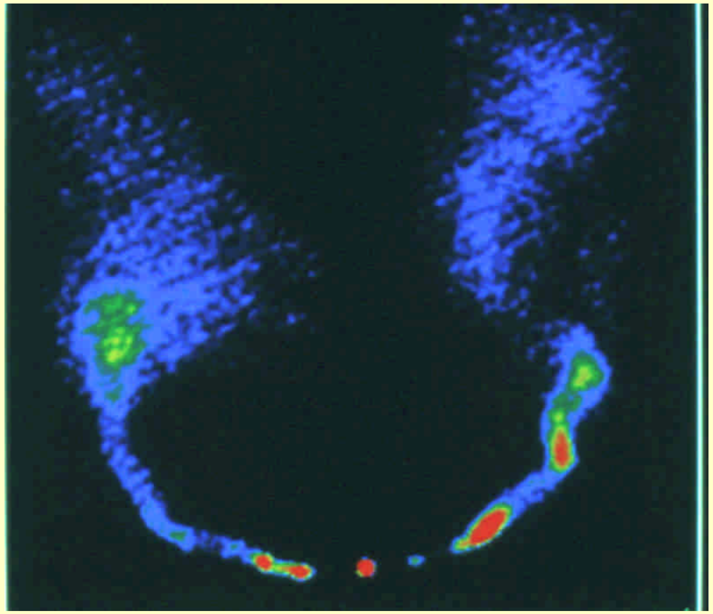

GEMINI
Cone Nebula
Betelgeuse
ORION
Rosette
Nebula
MONOCEROS
Horsehead Nebula
Rigel
Orion Nebula
CANIS MAJOR
LEPUS
Sirius



R I V U X G
Jet
Nucleus
Dust lane
Radio lobes





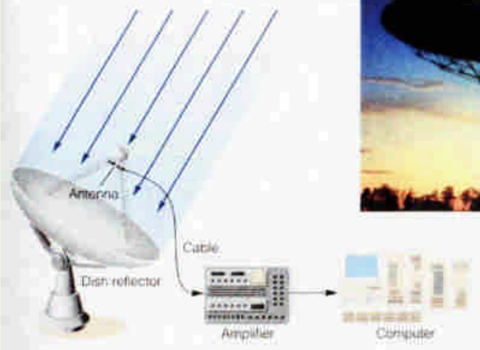
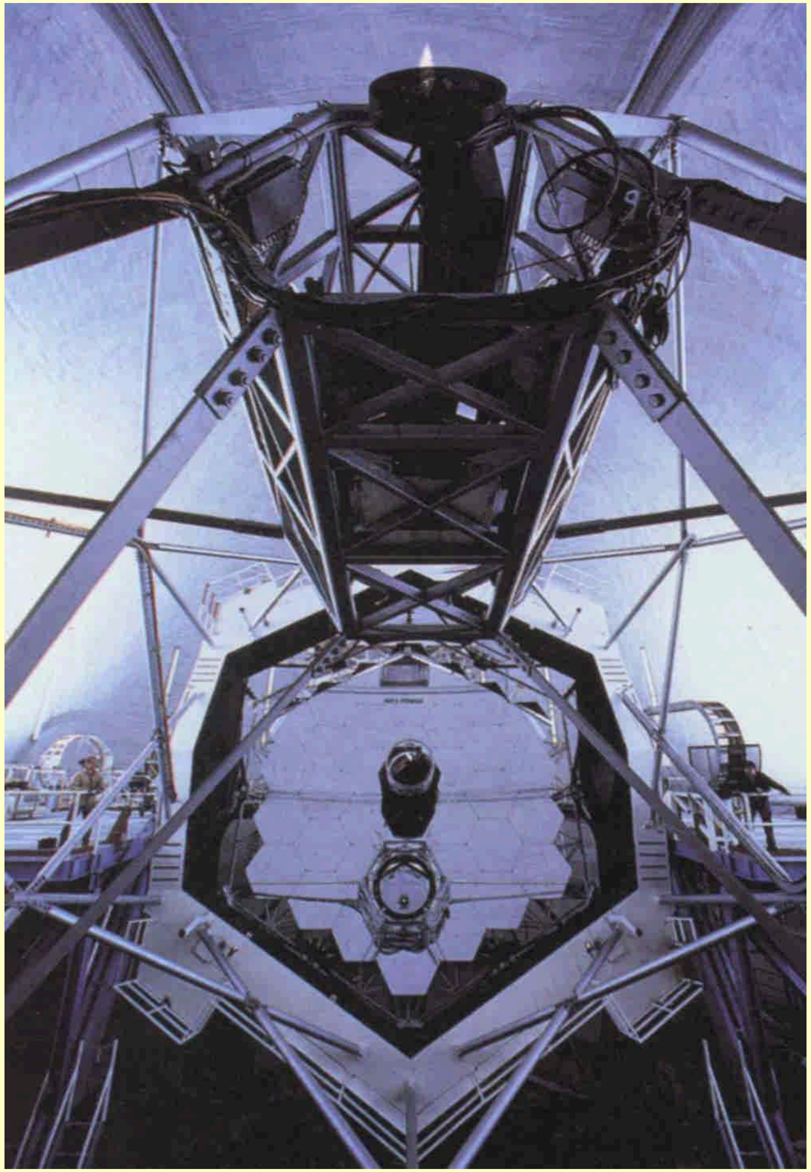
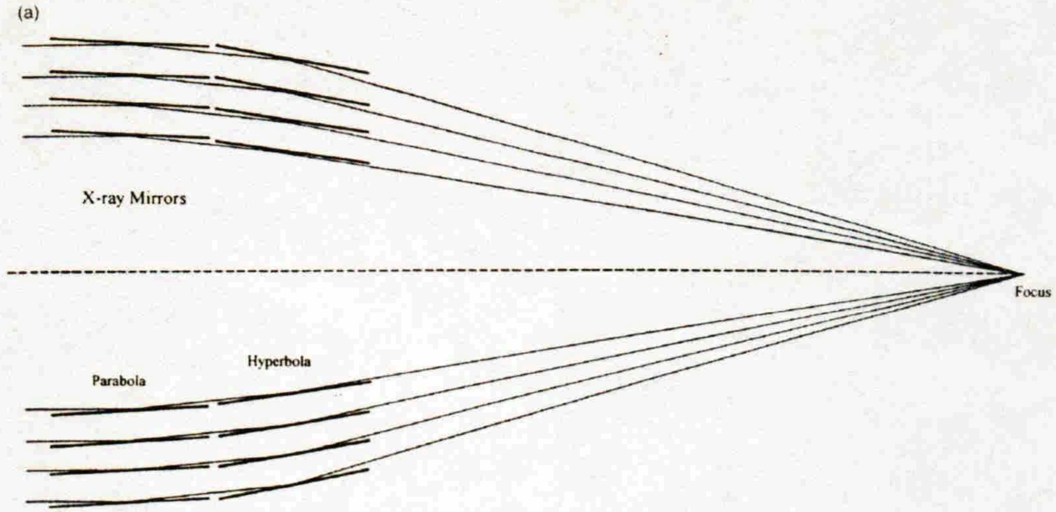


FIGURE 6-17
In most radio telescopes, a dish reflector concentrates the radio signal on the antenna. The signal is then amplified and recorded. For all but the shortest radio waves, wire mesh is an adequate reflector (above). (Courtesy Seth Shostak/SETI Institute.)





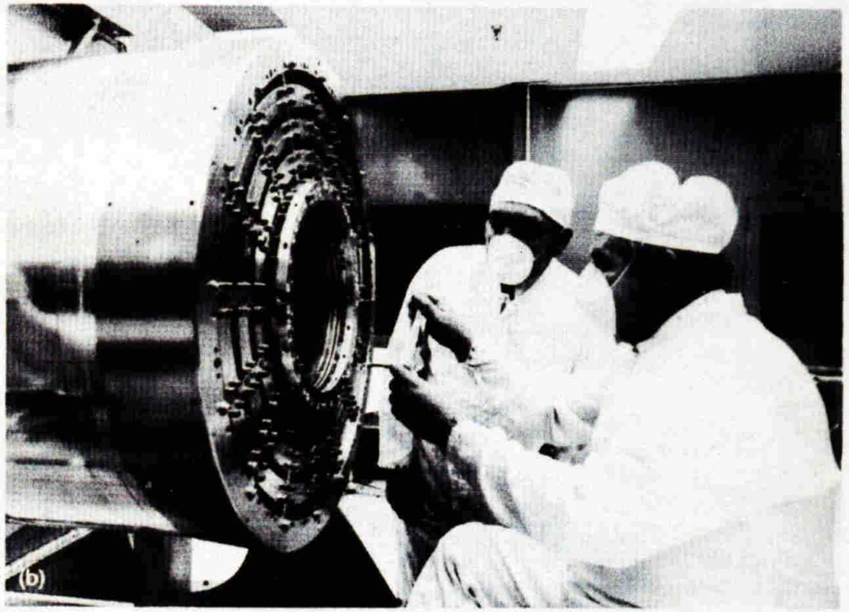
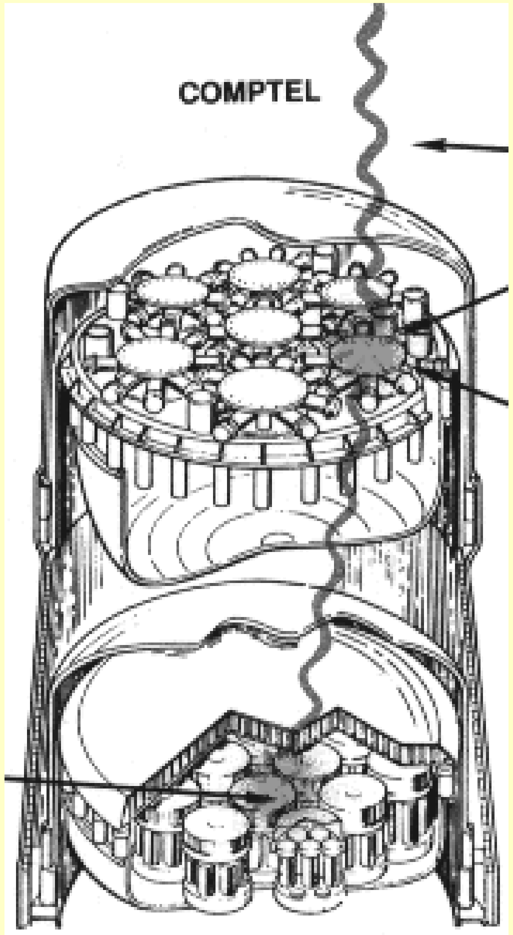
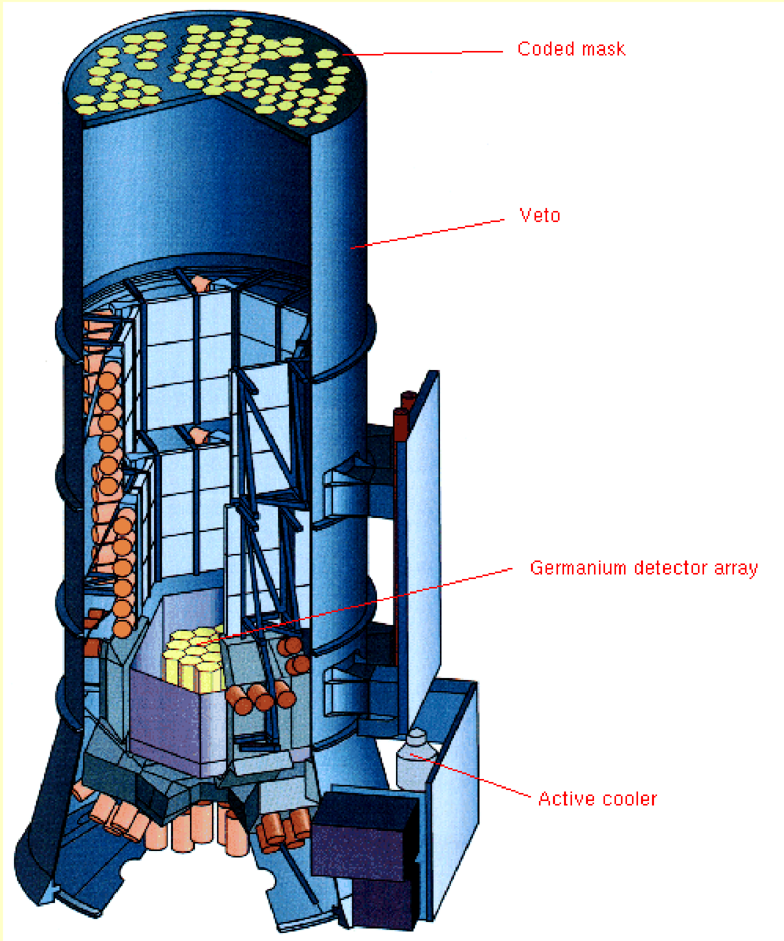


Fig. 2.7 X-ray reflection at grazing incidence and the X-ray optics first pioneered by Wolter. (a) X-rays incident on a mirror at large angles are scattered, not focused. This limits the grazing incidence technique to energies below 10 keV, with most X-ray telescopes concentrating on the 0.1–2 keV band, i.e. soft X-rays. (b) The photograph shows how this work was put into practice on the Einstein Observatory's set of nested X-ray mirrors. Nesting *enables the effective collecting area to be maximised. A single grazing incidence mirror collects only a small fraction of the light that would be collected by a normal incidence telescope mirror. The X-rays enter the telescope through the concentric annuli and are focused by the mirrors behind. (Photograph by Leon van Speybroeck of CfA.)*

much more sophisticated than the simple wire shown earlier in figure 2.1 as

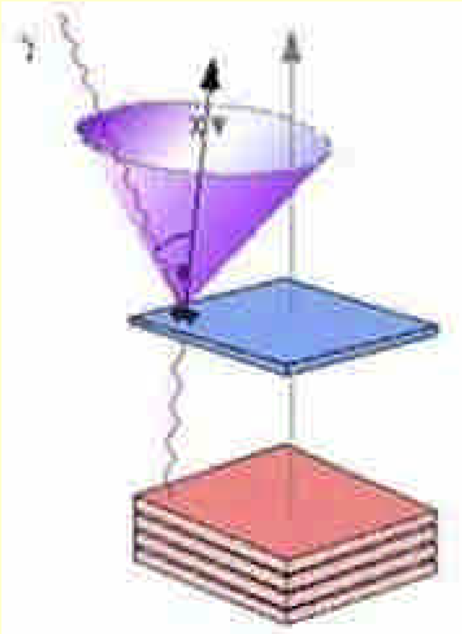


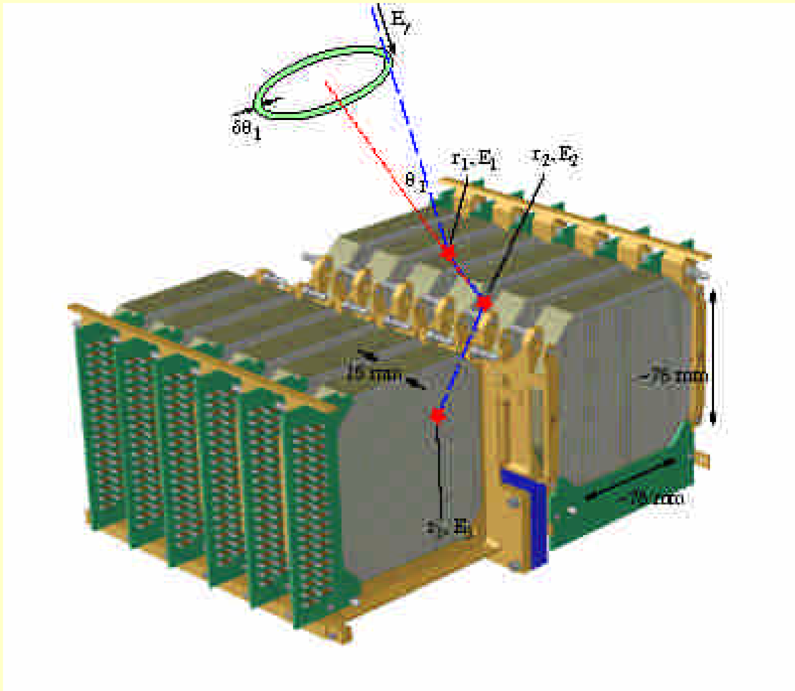
CGRO/COMPTEL



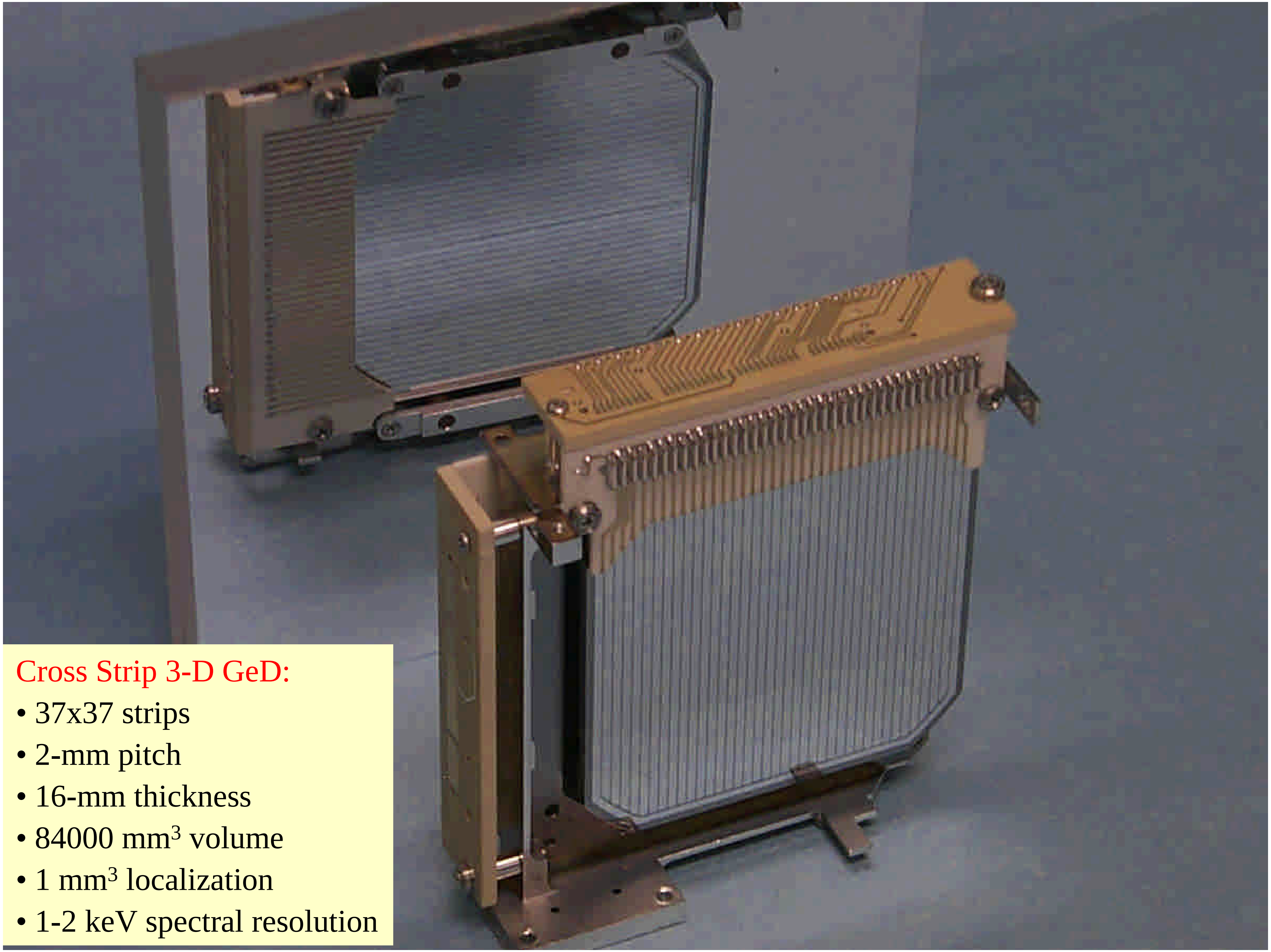
INTEGRAL/SPI

NCT: basic design





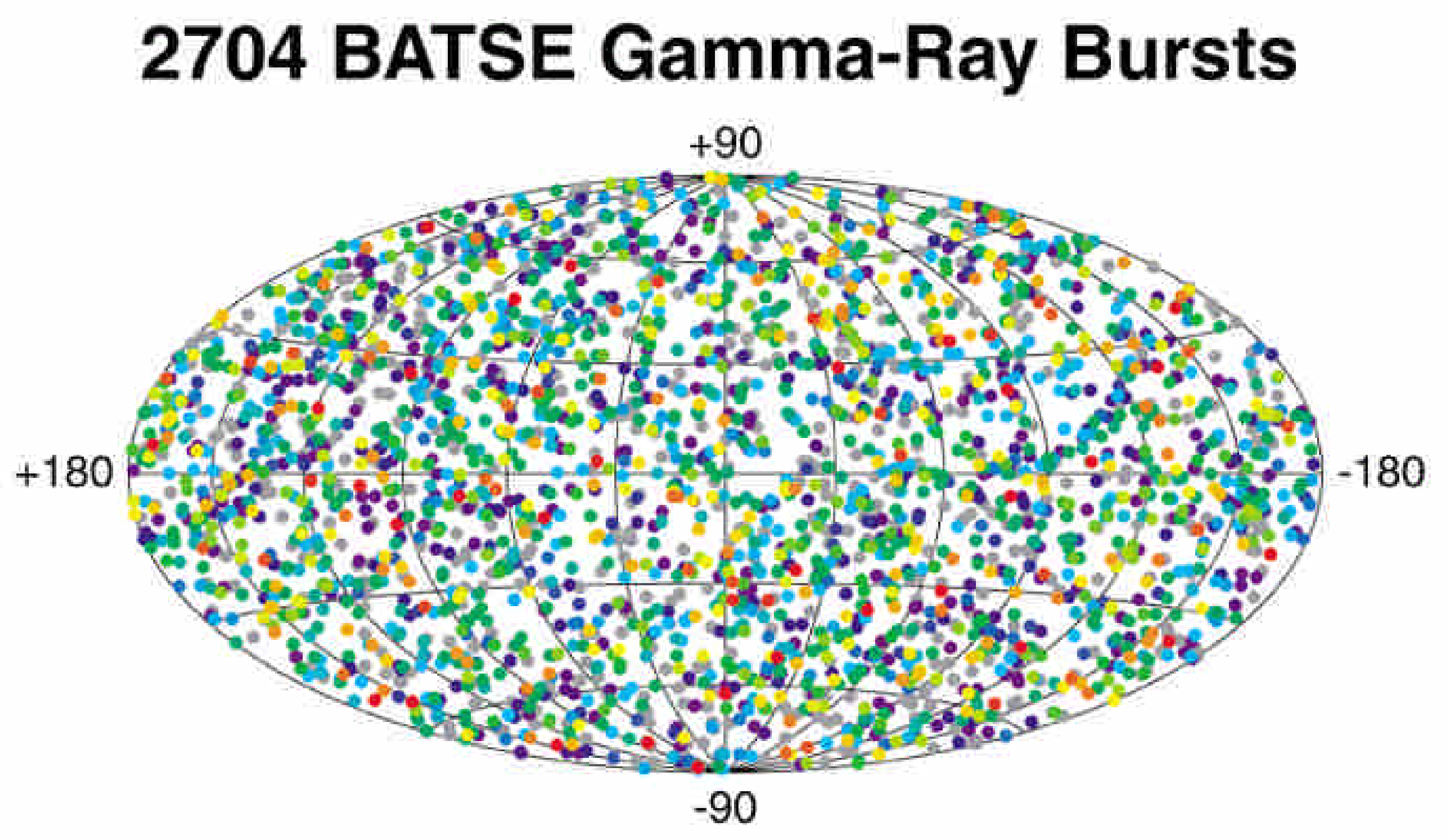
The principle of a Compton detector (left panel) and the Compton Nuclear Telescope (NCT, right panel), which consists of 12 cross-strip 3-D germanium detectors.



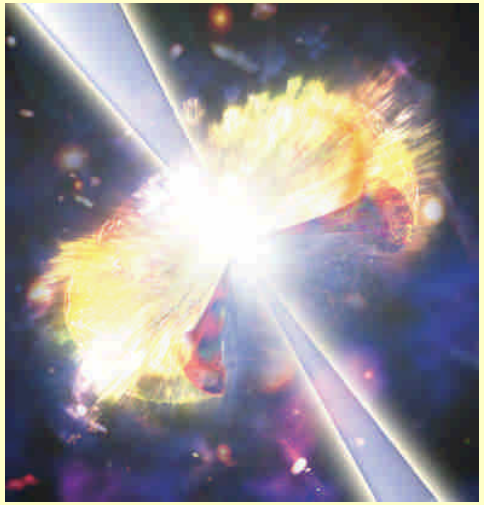
Cross Strip 3-D GeD:

- 37x37 strips
- 2-mm pitch
- 16-mm thickness
- 84000 mm^3 volume
- 1 mm^3 localization
- 1-2 keV spectral resolution

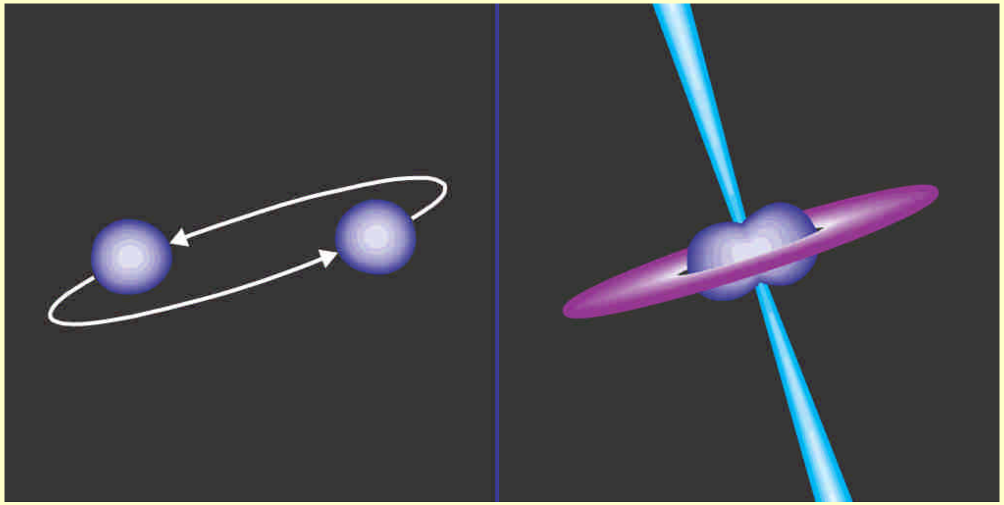
Scientific overview: GRBs



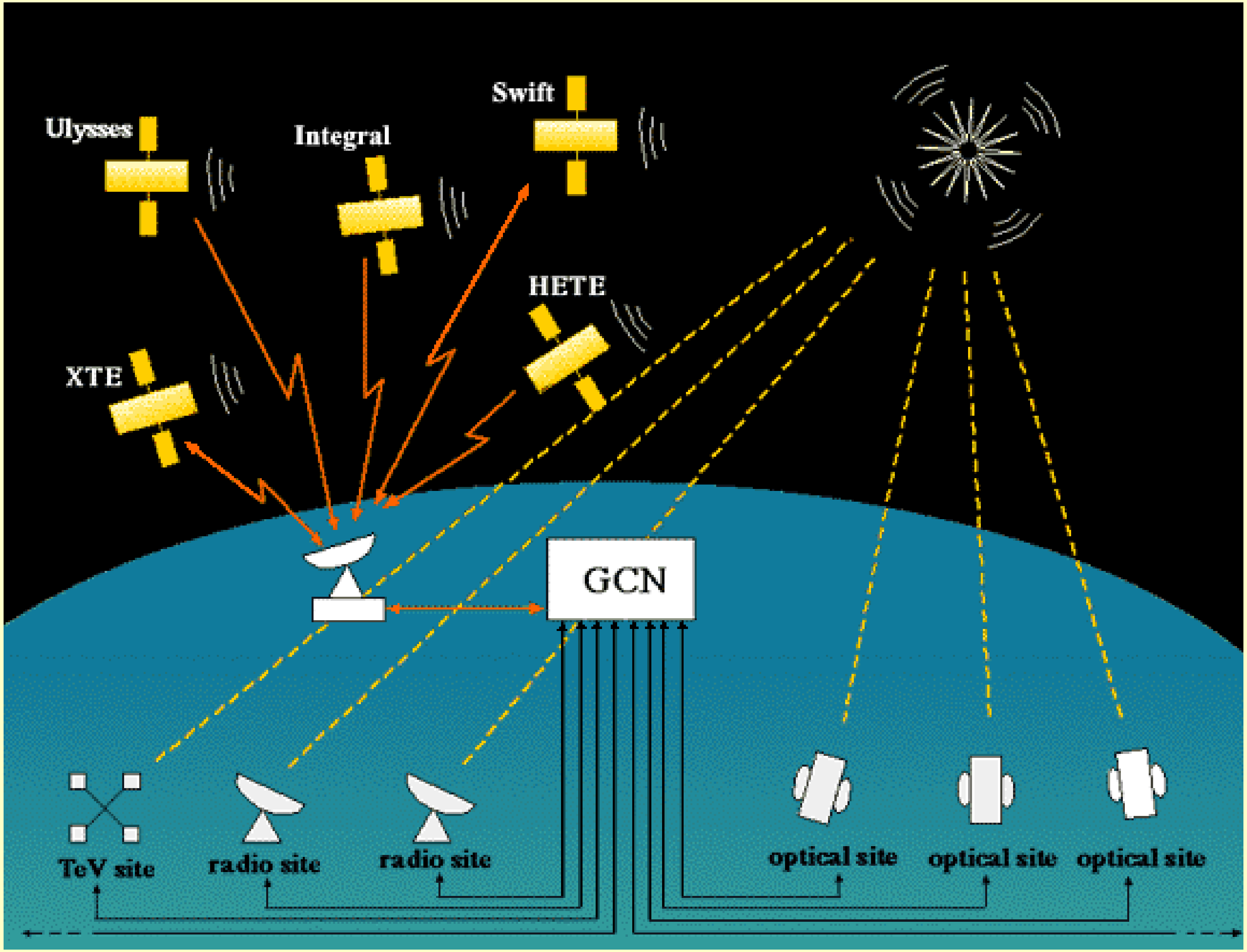
Birth of a Black Hole



- Long bursts (>2 seconds) may be from a hypernova: a super-supernova
- Short bursts (<2 s) may be from merging neutron stars
- Both create nature's vacuum cleaner: a black hole!



Scientific overview: GRBs

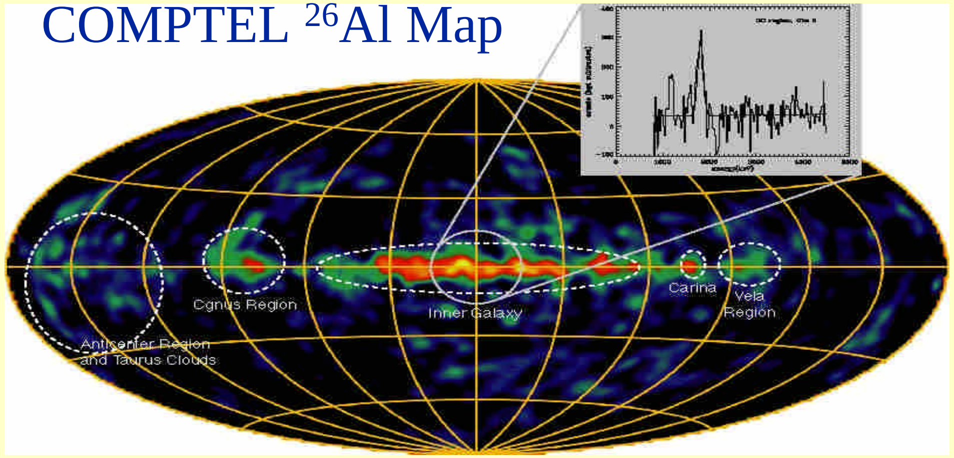


Scientific overview: 1.809-MeV line; 0.511-MeV line

History of nucleosynthesis in our Galaxy

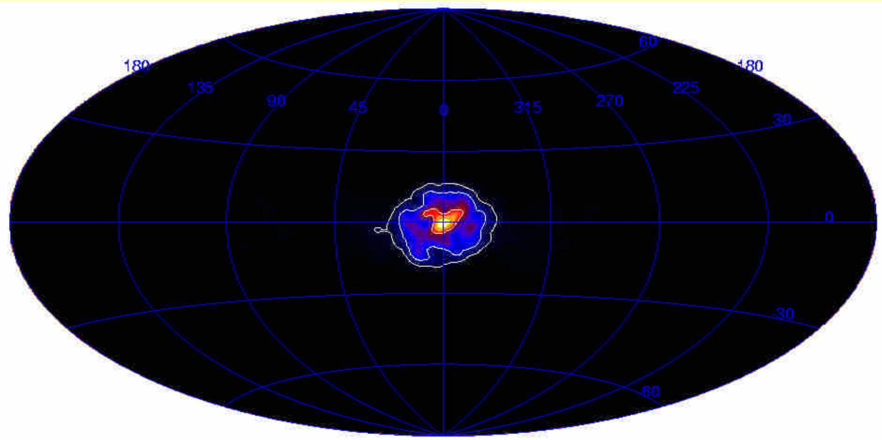
Nuclear Radioactive Emission

COMPTEL ^{26}Al Map



(Oberlack et al. 1996)

INTEGRAL/SPI All-Sky 0.511-MeV Map

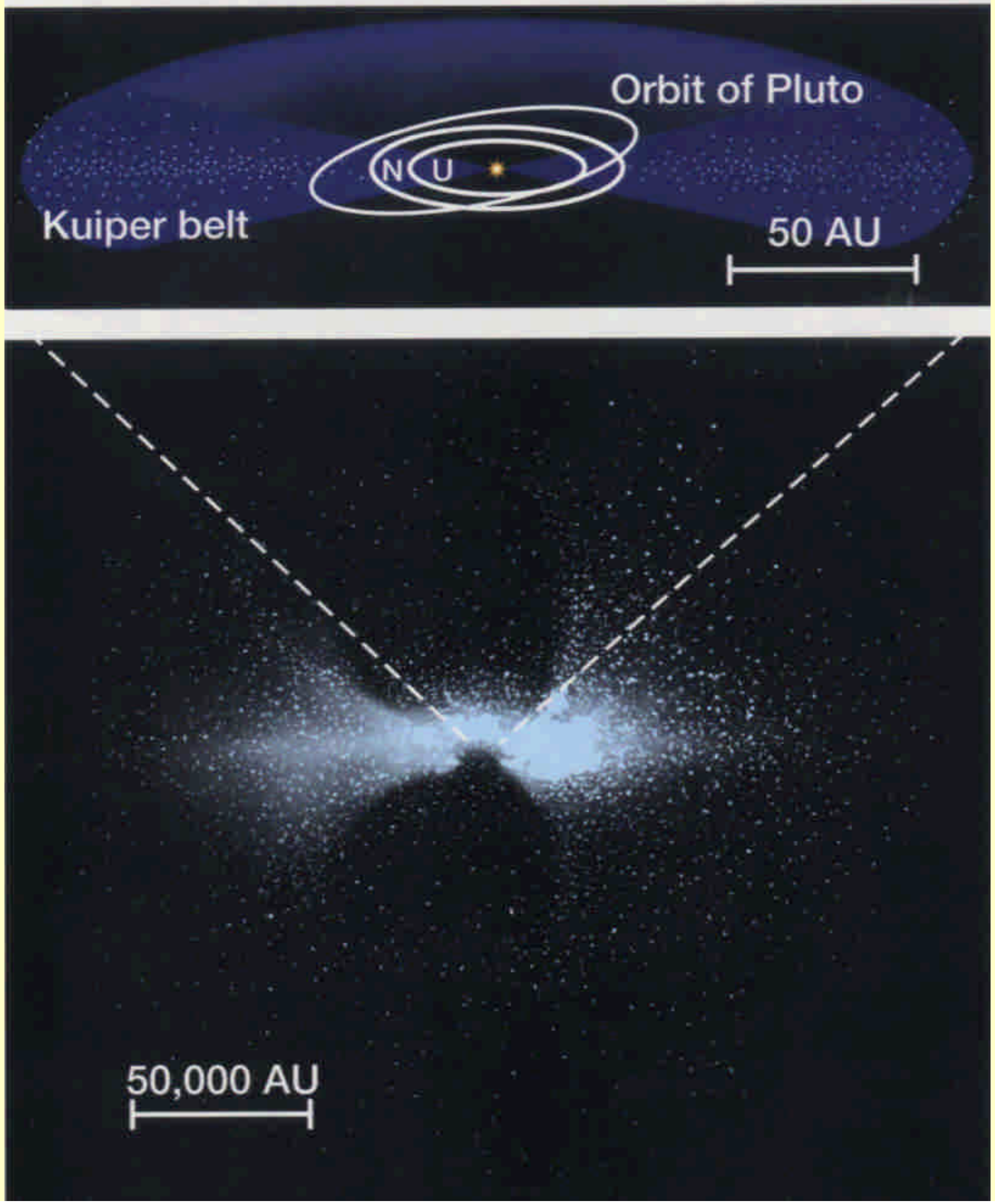


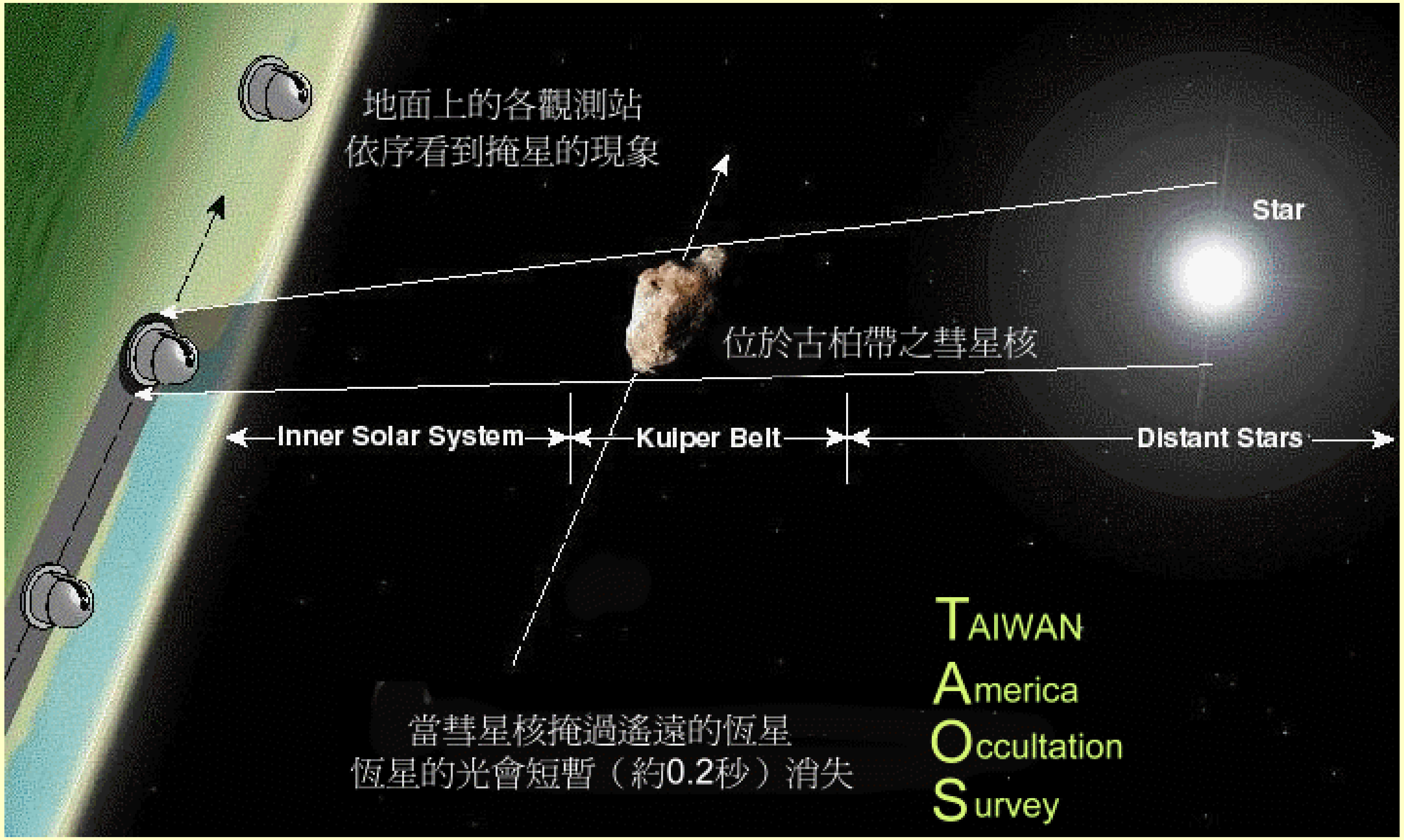
(Knodelseder et al. 2005)

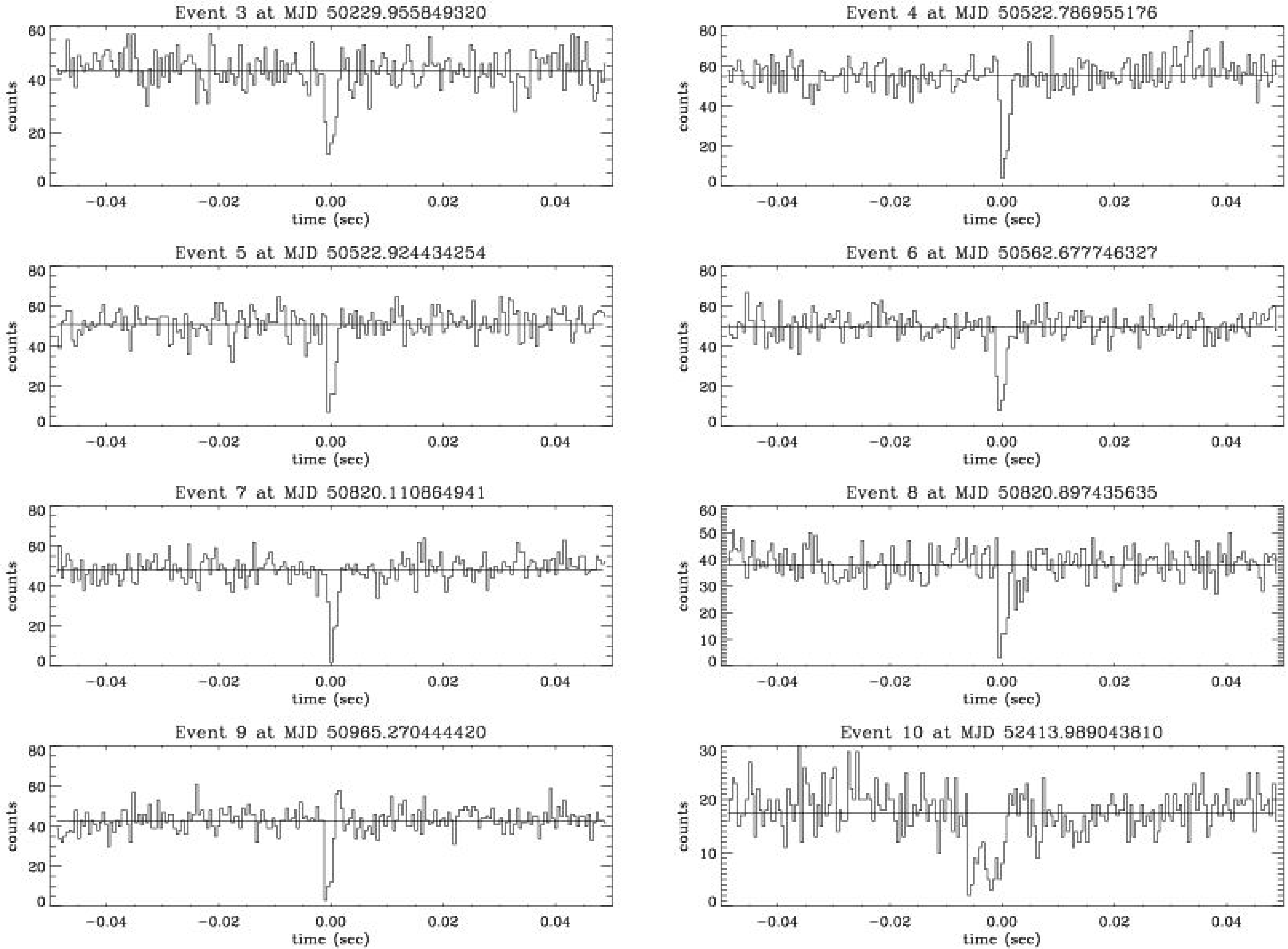
Exotic physics at our Galaxy's core?

Electron-Positron Annihilation

Oort and Kuiper belts




地面上的各觀測站
依序看到掩星的現象
Star
位於古柏帶之彗星核
Inner Solar System
Kuiper Belt
Distant Stars
TAIWAN
America
Occultation
Survey
當彗星核掩過遙遠的恆星
恆星的光會短暫（約0.2秒）消失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Event 4 at MJD 50522.786955176
Event 5 at MJD 50522.924434254
Event 6 at MJD 50562.677746327
Event 7 at MJD 50820.110864941
Event 8 at MJD 50820.897435635
Event 9 at MJD 50965.270444420
Event 10 at MJD 52413.989043810
counts
time (sec)